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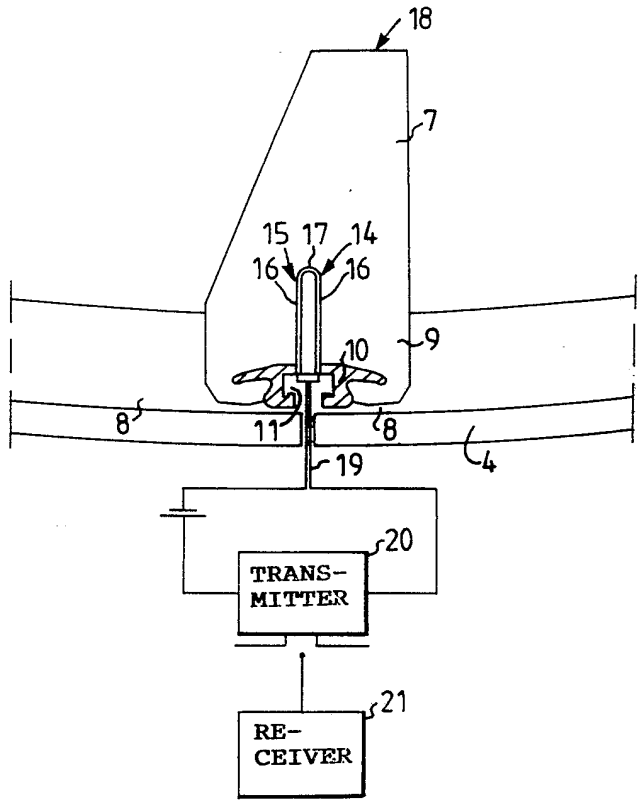
(54) Title: AN ARRANGEMENT FOR REGISTERING WEAR IN THE LINING OF A ROTARY MILL DRUM

(57) Abstract

The invention pertains to a rotary grinding mill having a drum which is provided with a lining and at least one lifting device, and relates to an arrangement for registering wear on the lining and particularly on its lifting device. In order to provide an arrangement by means of which it is possible to register when the lifting device of the mill lining has been worn to at least a given, predetermined level of wear, it is suggested, among other things, that the lifting device (7) is fitted with at least one loop (15) whose radially inner end is located on a level which corresponds to the predetermined degree of wear on the lifting device (7) to be registered, and which forms part of a closed wear-indicating circuit (15, 19) which, immediately the loop is broken, delivers a signal which indicates the predetermined degree of wear to be registered.



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AN ARRANGEMENT FOR REGISTERING WEAR IN THE LINING OF A ROTARY MILL DRUM

The present invention relates to an arrangement for at least registering the wear of mill linings, and particularly, but not exclusively, the wear of lifting devices mounted in mill linings.

There has long been a desire and a need for the possibility of monitoring and registering the wear of mill linings, and then in particular the wear of lifting devices included in mill linings, without needing to stop the mill and inspect for wear. This desire, or need, has been greatly accentuated in recent times, because of the higher demands placed on improved profitability and efficiency now required of this particular type of mill.

Accordingly, the object of the present invention is to provide an arrangement which will enable wear on the lifting devices of the mill lining to be registered when said devices have worn down to at least a predetermined extent, for example when the lifting devices have worn down completely and need to be changed. Preferably, it will also be possible to record the wear in progress and, in accordance with the invention, to enable several, predetermined degrees of wear to be registered, thereby also achieving continuous monitoring of the wear and a measurement of the rate at which the lifting devices are worn down.

This and other objects of the invention are achieved with the inventive arrangement having the characteristic features set forth in the following Claims. In principle, the inventive arrangement includes a lifting device

on which there is arranged a loop whose radially inner end is located on a level which corresponds to that extent of wear on the lifting device which it is desired to register, said loop forming a part of a closed wear-indicating circuit or wear signal circuit which, immediately the circuit is broken, will deliver a signal to a transmitter, which transmits the signal to a receiver for at least registering the signal.

The aforesaid signal circuit may comprise a transmitter current supply circuit, in which case the loop arranged in respective lifting devices will be electrically conductive and may, for instance, have the form of a U-shaped loop of steel wire or preferably spring steel, with the legs of the loop facing outwards towards the drum casing. When a lifting device equipped with a wear indicator or spring steel loop of this kind, in accordance with the invention, has been worn down to an extent such that the part of the spring steel loop which connects the legs has been worn completely away, the loop is broken and therewith also the supply of current to the transmitter, which quietens as a result thereof and therewith produces a signal necessary for registering the predetermined degree of wear on the lifting device concerned.

The present invention will now be described in more detail with reference to the accompanying drawings, in which Figure 1 is a cross-sectional view of a rotary mill drum having an internal lining; Figure 2 is a sectional view of a lifting device mounted in the drum lining and provided with a device constructed in accordance with the present invention; and Figure 3 is a sectional view of a lifting device mounted in the drum lining and provided with a modified embodiment of the inventive device.

Shown in Figure 1 is a driven, ore-grinding mill drum, generally referenced 1, which under normal conditions is caused to rotate about its rotational axle 3 in the direction of the arrows 2 at a predetermined speed, although this speed may be changed during operation of the mill as required. The drum 1 has provided on the inner surface 5 of the drum casing 4 a lining 6 which is comprised of wear elements in the form of lifting devices 7, which are generally parallel with the rotational axle 3 of the drum, and plates 8 which are generally shorter than the lowest of the lifting devices 7. The end part 9 of each lifting device 7 that faces towards the drum casing 4 is provided with a grooved or channeled attachment bar 10 which extends along the full length of the lifting device 7 and the groove or channel 11 of which is intended to receive attachment bolts for clamping of the lifting device 7 and therewith also clamping of adjacent wear plates 8 firmly against the drum casing 4, with the aid of nuts fitted to the attachment bolts from outside the drum casing 4, in a known manner.

According to the present invention, the lifting devices 7 are made of an elastomeric material, for instance wear-resistant rubber, and the wear plates 8 of the mill lining may be made of the same elastomeric material as or a similar elastomeric material to the lifting devices 7, or may be made of a metallic wear-resistant material, for instance steel, preferably a chromium-molybdenum alloyed steel, at least in the surface layer. The lifting devices 7 of the mill lining shown in Figure 1 have varying heights, and more specifically each alternate lifting device is high and each other alternate lifting device is low, although in accordance with a second embodiment of the present invention, all lifting devices

in the mill lining may have mutually the same height, preferably the same height as the higher lifting devices in the embodiment of the mill lining shown in Figure 1.

In Figure 1, the mill drum 1 is shown to rotate in the direction indicated by the arrows 2 and contains a grinding charge 12 which includes grinding bodies that may be comprised of the actual grinding material itself, as in the case of an autogenous grinding process, or of the actual grinding material itself and steel balls, as in the case of a semi-autogenous grinding process, or solely of steel balls or steel rods, as in the case of a conventional grinding process. The grinding charge 12 present in the rotary mill drum subjects the mill lining 6, and particularly its lifting devices 7, to considerable wear, and in order to enable this wear to be registered without needing to stop the mill and examine for wear, there is provided, in accordance with the present invention, a wear indicator 14 in at least one, lifting device, preferably more than one lifting device 7 in the mill lining.

In the illustrated embodiment of the inventive arrangement, the wear indicator 14 is comprised of a loop 15, preferably a U-shaped loop, formed from an electrically conductive material, such as steel wire or preferably spring steel. The loop 15 may be molded into the elastomeric and non-electrically conductive lifting device 7, or secured thereto in some other way. The U-shaped loop 15 mounted in the lifting device includes two mutually parallel, or essentially parallel legs 16 which are joined by means of a crosspiece 17 and extend generally radially inwards from the lifting device attachment bar 10 and terminate with the crosspiece 17 spaced at a predetermined distance from the outer or inner surface of the mill casing, or the inner, longitudinally

extending end surface 18 of an unused lifting device. The loop may be connected to the lifting device attachment bar 10 and, if the bar is electrically conductive, it is necessary to insulate the loop 15 from the bar.

According to the present invention, the loop 15 provided in the lifting device 7 forms part of the current supply circuit 19 of a transmitter 20 positioned outside the drum casing. The transmitter 20 is preferably a digital-type transmitter and transmits the signals delivered thereto to a receiver 21 which, in turn, may be connected to a data processing unit, such as a minicomputer or the like.

When the respective lifting devices 7 are worn down to the level of the wear indicator 14, the crosspiece 17 will become worn and therewith break the supply voltage in the current supply circuit 19 to the transmitter 20, which therewith quietens. This quieting of the transmitter 20 produces a signal in the form of a signal lapse, which is transmitted to the receiver 21 and further to the data operating and/or data processing unit (not shown) connected to the receiver 21. In other words, when a lifting device 7 fitted with a wear indicator 14 has been worn down to a predetermined extent or level and when this level is the level at which the worn lifting devices should be replaced with new lifting devices, information is obtained to this effect without needing to stop the mill drum and inspect the same.

By fitting one and the same lifting device or different lifting devices, with wear-indicating loops 15 of mutually different lengths, signals are obtained continually as wearing of the lifting device or devices continues, and with knowledge of the length or level differences between the loops 15 of mutually different lengths, it

is also possible to obtain knowledge of the rate at which the lifting devices are worn down and also to obtain practically continual registration of the wear.

In the case of the embodiment illustrated in Figures 1 and 2, the wear-indicating loop 15 is arranged so that both of its legs 16 will be located in a plane parallel with the plane of the drawing, i.e. in the rotational plane of the drum, although each loop 15 may also be arranged in respective lifting devices so that when the lifting device is not activated, the legs 16 of the loop 15 will be located in a radial plane parallel with the rotational axle 3 of the drum. In this case, the loop 15, which is preferably made of spring steel, is able to accompany the deflections of the lifting device caused by the load exerted by the grinding charge, as illustrated in Figure 3. In this case, the spring steel loop 15 is provided with a bending or flexing indicator 23, such as a wire strain gauge, which registers bending of the loop, and therewith also the lifting device, and the output signal of which may suitably be proportional to the extent to which the loop is bent. The wire strain gauge 23, or some equivalent tension or bending indicator, is connected through a circuit 24 to a transmitter 25 provided on the outside of the drum. The transmitter is suitably of the telemetry kind and signals obtained from the strain gauge 23 are telemetered preferably to the same receiver 21 as that used for the wear-indicating circuit 15, 19. Since the latter circuit is galvanically quite separate from the bending indicator circuit 23, 24, the transmitters 20, 25 may be operated completely independent of one another, meaning, for instance, that the bending indicator 23 can be activated when desired, in response to commands from the operator, for instance so as to obtain knowledge of the extent to which the lifting devices are bent or deflected over

short periods of time, while the wear-indicating circuit 15, 19 may be constantly activated. Furthermore, the bend indicator enables bending of respective lifting devices to be visualized with the aid of an oscilloscope, analog indicating instruments or writers.

Thus, the inventive arrangement is able to produce signals which will at least indicate that a lifting device is worn and must be replaced. Furthermore, it is possible to obtain information relating to predetermined degrees of wear and to carry out continuous or intermittent measurement and registration of the extent to which respective lifting devices are bent or deflected.

It will be understood that the present invention is not restricted to the aforedescribed and illustrated embodiments thereof, since changes and modifications can be made within the scope of the inventive concept defined in the following Claims.

CLAIMS

1. An arrangement for registering wear on the lining of a rotary grinding mill drum provided with a lining that includes at least one lifting device, and particularly for registering the wear on the lifting device, c h a r a c t e r i z e d in that the lifting device (7) is provided with at least one loop (15) whose radially inner end is located on a level which corresponds to the predetermined degree of wear on the lifting device (7) to be registered and which forms part of a closed wear-indicating circuit (15, 19) which, immediately it is broken, produces a signal which indicates the predetermined degree of wear to be registered.

2. An arrangement according to Claim 1, c h a r a c t e r i z e d in that the loop (15) has an essentially U-shape with the legs (16) of the U facing towards the drum casing (4) and with the crosspiece (17) connecting the legs (16) of said U located at said predetermined level.

3. An arrangement according to Claim 1 or 2, in which the mill lining includes more than one elastomeric lifting device, c h a r a c t e r i z e d in that a plurality of loops (15) of mutually different lengths are arranged in one and the same lifting device (7) or in different lifting devices (7) for registration of different degrees of wear.

4. An arrangement according to any one of the preceding Claims, c h a r a c t e r i z e d in that in addition to the loop (15) arranged in respective lifting devices, the wear-indicating circuit further includes a current supply circuit (19) which supplies current to a

transmitter (20) for transmitting each signal to the registering unit, via a receiver (21).

5. An arrangement according to any one of the preceding Claims, c h a r a c t e r i z e d in that each loop (15) provided in a lifting device is provided with a bend indicator (23) which functions to measure and register bending or flexing of the lifting device caused by the load exerted by the grinding charge, said bend indicator (23) being connected to an individual transmitter (25) whose receiver is the same receiver as that which coacts with the wear-indicating circuit (15, 19).

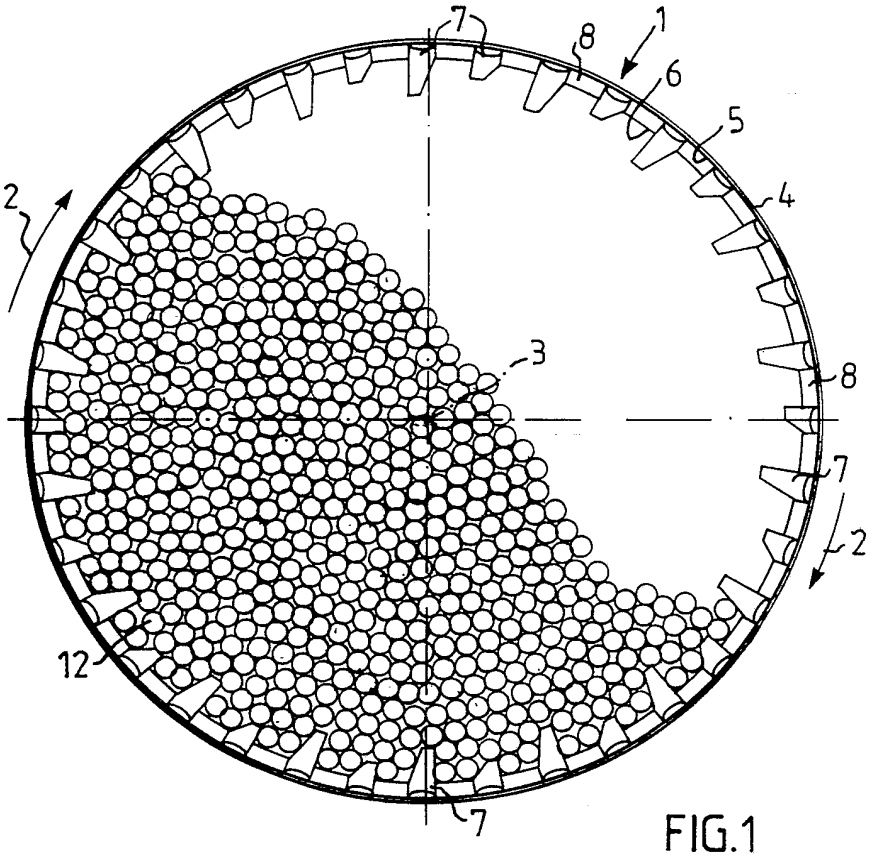

FIG.1

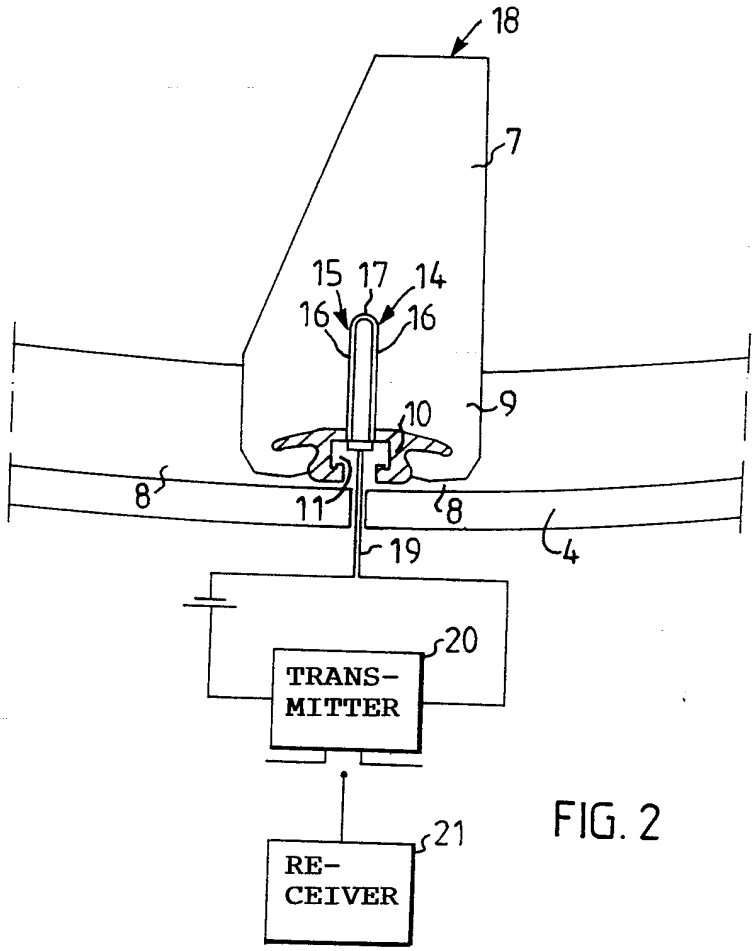

FIG. 2

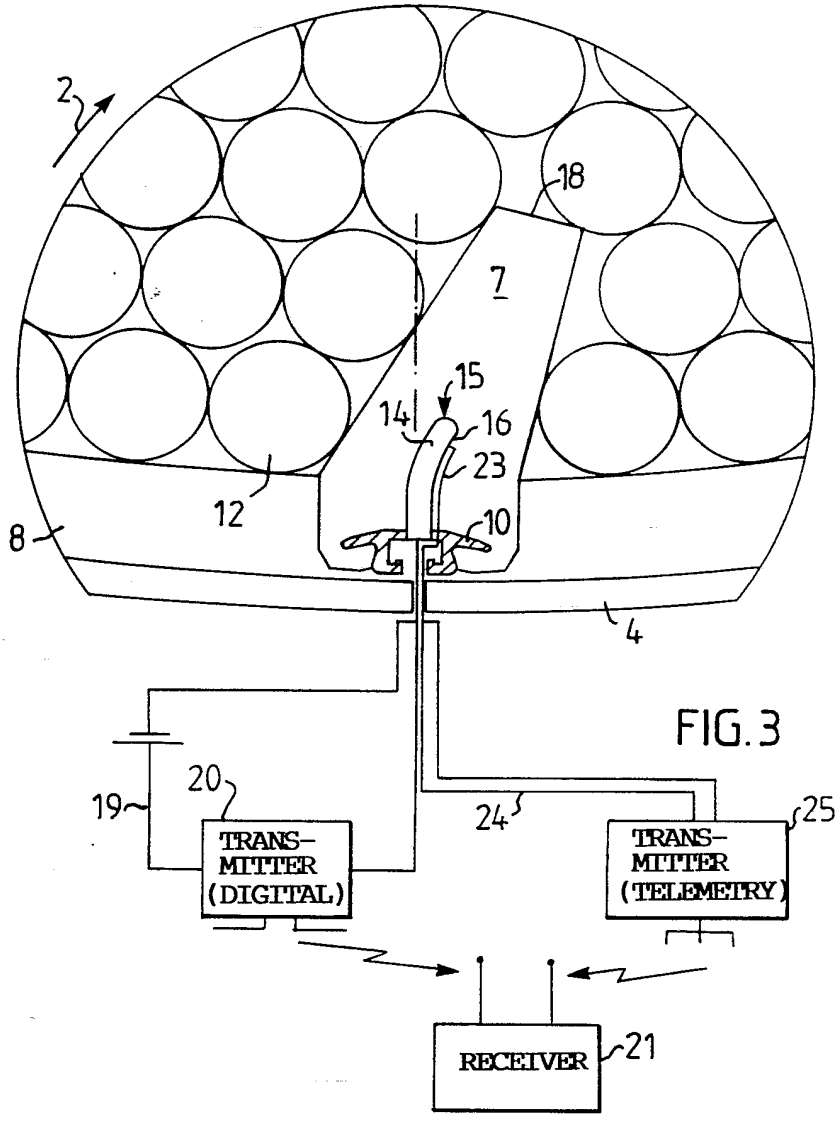
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FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 92/00440

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: B 02 C 17/18, 17/22

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	B 02 C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	AU, B, 605794 (SKEGA AB) 24 January 1991, see page 2a, line 32 - page 3, line 12; figures 3-5 --	1-5

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
14th October 1992	19 -10- 1992
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Wiva Asplund

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 92/00440

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 30/09/92
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
AU-B- 605794	91-01-24	AU-D-	7999887	88-12-08
		US-A-	4848681	89-07-18
		ZA-A-	8707835	88-11-28